

REMARKS

Favorable reconsideration is respectfully requested.

The claims are 12 to 17.

Claims 12 to 15 are rejected under 35 U.S.C. § 102(e) as being anticipated by Nakanishi et al. U.S. Patent Publication No. 2001/0016298 A1 of Application No. 09/770,212 filed January 20, 2001.

Further, claim 16 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakanishi cited above in view of Yako et al. U.S. Patent No. 5,985,511.

Lastly, claim 17 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakanishi cited above in view of Oomori et al. U.S. Patent No. 6,387,587 cited in the prior office action and Yako cited above.

These rejections are respectfully traversed.

The effective date of Nakanishi et al. is January 29, 2001.

On the other hand, the effective date of the present application is December 4, 2000 which is the filing date of its Japanese priority application.

A certified copy of the Japanese priority application is of record and a verified English translation is submitted herewith.

This translation supports the present claims in all essential respects.

In this regard, priority application claim 1 recites the components (A), (B), and (C) of present claim 12 as well as the three different types of monomeric units (a1), (a2) and (a3) constituting the component (A) in substantially the same way as in instant claim 12 except for the relative amounts of the components (A), (B), and (C) and the molar fractions of the monomeric units (a1), (a2), and (a3).

The features unspecified in claim 1 of the priority application are disclosed in the description of the priority application. Thus, the amount of component (B) relative to the component (A) is disclosed in paragraph [0021] and the molar fractions of the monomeric units are disclosed in paragraph [0015].


For the foregoing reasons, it is apparent that the rejections on prior art are untenable and should be withdrawn.

A Supplemental Information Disclosure Statement accompanies.

No further issues remaining, allowance of this application is respectfully requested.

Respectfully submitted,

Hideo HADA et al.

By: 
Matthew Jacob
Registration No. 25,154
Attorney for Applicants

MJ/jlg
Washington, D.C. 20006-1021
Telephone (202) 721-8200
Facsimile (202) 721-8250
June 23, 2003



PATENT OFFICE
JAPANESE GOVERNMENT

RECEIVED
JUN 26 2003
TC 1700

This is to certify that the annexed is a true copy of
the following application as filed with this office.

Date of Application:	December 4, 2000
Application Number:	Patent Application No. 2000-369225
Applicant:	TOKYO OHKA KOGYO CO., LTD.

October 26, 2001

Commissioner,
Patent Office OIKAWA, Kozo (Seal)

Certificate No. 2001-3095140

[Name of document] Application for patent
[Case number] PTOK00-109
[Date of filing] December 4, 2000
[Address] Mr. OIKAWA, Kozo
Commissioner of Patent Office

RECEIVED
JUN 26 2003
TC 1700

[International patent classification] G03F 7/004

[Inventor]

[Residence or address] c/o TOKYO OHKA KOGYO CO., LTD.
150, Nakamaruko, Nakahara-ku,
Kawasaki-shi, Kanagawa-ken

[Name] HADA, Hideo

[Inventor]

[Residence or address] c/o TOKYO OHKA KOGYO CO., LTD.
150, Nakamaruko, Nakahara-ku,
Kawasaki-shi, Kanagawa-ken

[Name] FUJIMURA, Satoshi

[Inventor]

[Residence or address] c/o TOKYO OHKA KOGYO CO., LTD.
150, Nakamaruko, Nakahara-ku,
Kawasaki-shi, Kanagawa-ken

[Name] SASAKI, Kazuhito

[Inventor]

[Residence or address] c/o TOKYO OHKA KOGYO CO., LTD.
150, Nakamaruko, Nakahara-ku,
Kawasaki-shi, Kanagawa-ken

[Name] IWAI, Takeshi

[Applicant for patent]

[Identification number] 000220239

[Personal or corporate name] TOKYO OHKA KOGYO CO., LTD.

[Representative] YOKOTA, Akira

[Attorney]

[Identification number] 100071825

[Patent Attorney]

[Personal or corporate name] AGATA, Akira

[Designated Attorney]

[Identification number] 100095153

[Patent Attorney]

[Personal or corporate name] MIZUGUCHI, Takatoshi

[Indication of official fee]

[Deposit number] 033547

[Amount paid] 21000 yen

[List of submission]

[Name of submission] Specification 1

[Name of submission] Abstract 1

[Proof requested or not] Yes

[Name of document] Specification

[Title of the invention] POSITIVE-WORKING RESIST COMPOSITION

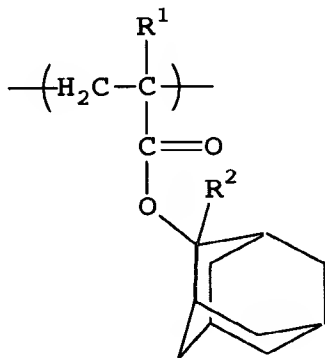
[The claims]

[Claim 1] A positive-working resist composition characterized in that, in a chemical-amplification positive-working resist composition containing a resin component (A) capable of being imparted with increased solubility in alkali by interacting with an acid, an acid-generating agent component (B) capable of generating an acid by irradiation with a radiation and an organic solvent component (C), the resin component (A) is a copolymer consisting of (a₁) constituent units derived from 2-alkyl-2-adamantyl acrylate or methacrylate, (a₂) constituent units derived from acrylate or methacrylate ester having an acid-dissociable 2-oxooxapentyl group and (a₃) constituent units derived from 1-hydroxyadamantyl acrylate or methacrylate.

[Claim 2] The positive-working resist composition according to claim 1 wherein the constituent unit (a₂) is that derived from an acid-dissociable acrylate or methacrylate ester in which the ester linkage is formed at 4-position of 2-oxooxapentyl group.

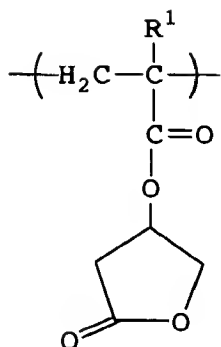
[Claim 3] The positive-working resist composition according to claims 1 or 2 wherein the resin component (A) is a copolymer consisting of (a₁) constituent units represented by the general formula

[Chem 1]

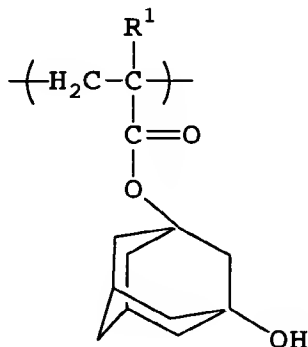


(R¹ in the formula is a hydrogen atom or a methyl group and R² is a lower alkyl group), (a₂) constituent units represented by the general formula

[Chem 2]



(R¹ in the formula has a same meaning described above), (a₃) constituent units represented by the general formula
[Chem 3]



(in the formula R¹ has a same meaning described above).

[Claim 4] The positive-working resist composition according to claims 1, 2 or 3 which contains the constituent units (a₃) in the range from 10 to 60% by moles.

[Claim 5] The positive-working resist composition according to claims 1 to 4 wherein the acid-generating agent component (B) is an onium salt having a fluorinated alkyl sulfonic acid ion as the anion.

[Claim 6] The positive-working resist composition according to either one of claims 1 to 5 which further contains a secondary or tertiary lower molecular aliphatic amine (D) in addition to the resin component (A), the acid-generating agent component (B) and the organic solvent component (C).

[Detailed description of the invention]

[0001]

[Technical Field to which the Invention belongs]

The present invention relates to a chemical-amplification positive-working resist composition suitable for process using 200 nm wavelength or shorter as a light source or, in particular, to a novel chemical-amplification positive-working resist composition capable of giving a fine resist pattern with little line slimming.

[0002]

[Prior art]

As the resin component in a chemical-amplification resist, those used heretofore include polyhydroxystyrenes having high transparency to the KrF excimer laser (248 nm) and those in which the hydroxyl groups thereof are protected by acid-dissociable solubility-reducing groups.

However, semiconductor devices are now on the way toward higher and higher fineness and development works are actively undertaken for a process by using ArF excimer laser (193 nm).

In the process using ArF excimer laser (193 nm) as light source, resins having benzene rings such as polyhydroxystyrenes have insufficient transparency to ArF excimer laser (193 nm).

[0003]

In order to solve this defect, there have become highlighted those resins having, as the constituent units, acrylic acid or methacrylic acid ester units containing, in place of the benzene ring, an adamantane ring introduced onto the main chain and a large number of chemical-amplification positive-working resist compositions containing a resin of this type have been proposed heretofore (Publications of Patent No. 2881969, Patent Kokai No. 5-346668, Patent Kokai No. 7-234511, Patent Kokai No. 9-73173, Patent Kokai No. 9-90637, Patent Kokai No. 10-161313, Patent Kokai No. 10-319595 and Patent Kokai No. 11-12326).

[0004]

And, recently, in a chemical-amplification positive-working resist composition for ArF excimer laser or KrF excimer laser, as one giving a resist pattern having high sensitivity and pattern resolution as well as excellent adhesion to the substrate and dry etching ability, it is proposed one using, as

the resin component, a copolymer of 3-hydroxy-1-adamantyl acrylate or methacrylate and acrylonitrile or methacrylonitrile (Patent Kokai No. 2000-137327).

[0005]

However, as the design rule required in the manufacture of semiconductor devices nowadays become narrower, a pattern resolution not exceeding 150 nm or in the vicinity of 100 nm is required and improvement of pattern resolution is desired. In addition, solution of line slimming is desired. Line slimming is a phenomenon that slimming of the formed resist pattern during inspection of the resist pattern by using a scanning electron microscope (SEM). According to the description in Journal of Photopolymer Science Technology, volume 13, No. 4, page 497 (2000), it is supposed that, by the exposure of the resist pattern by the electron beam used in the SEM, the crosslinking reaction proceeds to cause slimming.

The influence of such a problem of line slimming on the manufacturing of semiconductor devices becomes greater as the design rule becomes finer so that improvements in this regard are desired but a chemical-amplification positive-working resist composition capable of adequately complying thereto is not known heretofore.

[0006]

[Problem to be solved by the Invention]

The present invention has been completed with an object to provide a chemical-amplification positive-working resist composition capable of giving a fine resist pattern with little line slimming in addition to the excellent sensitivity and pattern resolution as well as good dry etching resistance and adhesion to the substrate, when a light source of 200 nm wavelength or shorter is used.

[0007]

[Means for solving Problem]

The inventors have continued extensive investigations to develop a chemical-amplification positive-working resist composition suitable for process using a light source of 200 nm wavelength or shorter and discovered that by using, as a resin

component, a copolymer consisting of constituent units derived from 2-alkyl-2-adamantyl acrylate or methacrylate and component units derived from acrylate or methacrylate ester having an acid-dissociable 2-oxooxapentyl group, a resist pattern having excellent sensitivity and pattern resolution as well as good dry etching resistance and adhesion to the substrate can be obtained, which, however, has a defect of large line slimming.

Therefore, the inventors continued investigations further and, as a result, arrived at a discovery that, unexpectedly, line slimming can be remarkably smaller by introducing further a 1-hydroxyadamantyl acrylate or methacrylate units into the above-described copolymer, leading to the establishment of the present invention based thereon.

[0008]

Namely, the present invention provides a positive-working resist composition characterized in that, in a chemical-amplification positive-working resist composition containing a resin component (A) capable of being imparted with increased solubility in alkali by interacting with an acid, an acid-generating agent component (B) capable of generating an acid by irradiation with a radiation and an organic solvent component (C), the resin component (A) is a copolymer consisting of (a_1) constituent units derived from 2-alkyl-2-adamantyl acrylate or methacrylate, (a_2) constituent units derived from acrylate or methacrylate ester having an acid-dissociable 2-oxooxapentyl group and (a_3) constituent units derived from 1-hydroxyadamantyl acrylate or methacrylate.

[0009]

[Embodiment of the Invention]

In the composition of the present invention, the resin component (A) is necessarily a resin capable of being imparted with increased solubility in alkali by the interaction with an acid and, usually, as such a resin, for example, used is a polymer or copolymer having, in the main chain, the constituent units derived from an acrylic acid ester or methacrylic acid ester having a solubility-reducing group.

[0010]

And, in the inventive positive-working resist composition, it is characterized in using, as the resin component capable of being imparted with increased solubility in alkali by interacting with an acid as the component (A), in particular, a copolymer comprising (a₁) the constituent units derived from 2-alkyl-2-adamantyl acrylate or methacrylate, (a₂) the constituent units derived from an acrylate or methacrylate ester having an acid-dissociable 2-oxooxapentyl group and (a₃) the constituent units derived from 1-hydroxyadamantyl acrylate or methacrylate.

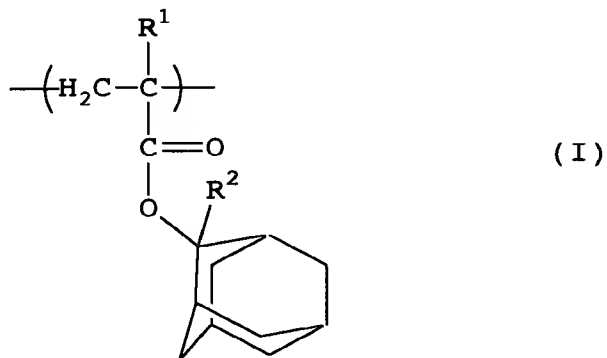
[0011]

Namely, in the present invention, by containing above described constituent units (a₁) and the constituent units (a₂), a resist pattern having good resistance against dry etching and adhesion to the substrate surface as well as high sensitivity and pattern resolution is formed and, by further addition of the constituent units (a₃), it is enable to give a resist pattern with little line slimming.

[0012]

As the above described constituent unit (a₁), those represented by the general formula

[Chem 4]



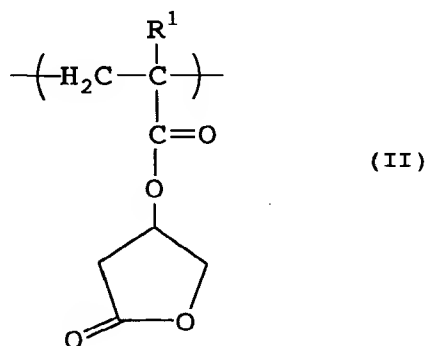
(R¹ in the formula is a hydrogen atom or a methyl group and R² is a lower alkyl group) are used. The lower alkyl group as R² in the formula is exemplified by methyl, ethyl and propyl groups and so on and as the carbon chain is longer, it become more dissociable by acids so that the sensitivity is improved. And since the 2-alkyladamantyl group is acid-dissociable, by an acid generated

by the exposure to light, an acrylic or methacrylic acid is produced so that the exposed areas show alkali-solubility while the unexposed areas show alkali-insolubility and resistance against dry etching due to the remaining adamantyl groups.

[0013]

Nextly, as the above described constituent unit (a_2), preferable are those derived from an acid-dissociable acrylate or methacrylate in which the ester linkage is formed at the 4-position of a 2-oxooxapentyl group and represented by the general formula

[Chem 5]



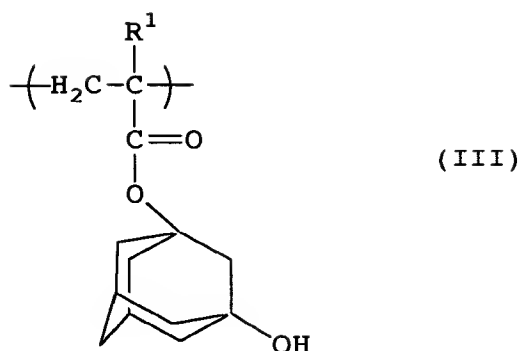
(R^1 in the formula has the same meaning described above).

This is acid-dissociable, by an acid generated by the exposure to light, an acrylic or methacrylic acid is produced so that the exposed areas show alkali-solubility while the unexposed areas show alkali-insolubility which play a role to improve the sensitivity and pattern resolution. Besides, since the unexposed areas have lactone groups, they play a role to improve the adhesion to the substrate.

[0014]

On the other hand, as the above described constituent unit (a_3), those represented by the general formula

[Chem 6]



(R¹ in the formula has the same meaning described above) are used.

Since this constituent unit (a₃) is acid-non-dissociable and has a bulk polycyclic adamantyl group, it shows good dry-etching resistance and plays a role to decrease line slimming due to its hydroxyl group which is a polar group.

[0015]

As the inventive resin component (A), used are those consisting of the constituent unit (a₁) in the range of from 20 to 80% or, preferably, from 30 to 60%, the constituent unit (a₂) in the range from 10 to 60% or, preferably, from 20 to 50% and the constituent unit (a₃) in the range from 10 to 60% or, preferably, from 20 to 40%.

Besides, a mass-average molecular weight of the resin component (A) in the present invention is selected in the range from 5,000 to 20,000 or, preferably, from 8,000 to 15,000.

[0016]

Moreover, in the composition of the present invention, it is optional that, as this resin component (A), the monomers forming the aforementioned respective constituent units are copolymerized for use adequately in combination according to need with an acrylic acid derivative or methacrylic acid derivative having a dry etching resistance improving group or acid-non-dissociable solubility-reducing group heretofore known in chemical-amplification positive-working resists, carboxylic acids having an ethylenic double bond to effect alkali-solubility such as acrylic acid, methacrylic acid, malic acid, fumaric acid and the like, known monomers used in the

preparation of an acrylic resin and others.

[0017]

The above-mentioned acrylic acid derivative is exemplified, for example, by the acrylic acid esters protected for the hydroxyl groups of the carboxyl group by a dry etching resistance improving group or acid-non-dissociable substituent group such as 1-adamantyl acrylate, 2-adamantyl acrylate, cyclohexyl acrylate, naphthyl acrylate, benzyl acrylate, 3-oxocyclohexyl acrylate, bicyclo[2.2.1]heptyl acrylate, tricyclodecanyl acrylate, ester of acrylic acid and terpineol, ester of acrylic acid and 3-bromoacetone and the like, and others. Besides, the methacrylic acid derivative is exemplified by the derivatives of methacrylic acid corresponding to these acrylic acid derivatives.

[0018]

Besides, the carboxylic acid having an ethylenic double bond is exemplified, for example, by acrylic acid, methacrylic acid, malic acid, fumaric acid and the like.

Examples of the known monomers used in the preparation of an acrylic resin include, for example, alkyl esters of acrylic acid such as methyl acrylate, ethyl acrylate, propyl acrylate, isopropyl acrylate, n-butyl acrylate, isobutyl acrylate, n-hexyl acrylate, octyl acrylate, 2-ethylhexyl acrylate, lauryl acrylate, 2-hydroxyethyl acrylate, 2-hydroxypropyl acrylate and the like as well as corresponding alkyl esters of methacrylic acid and others.

[0019]

Further, the resin component (A) can be easily prepared by known radical polymerization of the corresponding acrylic acid ester monomers using a radical polymerization initiator such as azobisisobutyronitrile (AIBN).

[0020]

As the acid-generating agent component (B) generating an acid by light exposure in the inventive composition, on the other hand, any one can be used by adequately selecting from those heretofore known as the acid-generating agent in chemical-amplification resists. Examples of this acid-

generating agent include onium salts such as diphenyliodonium hexafluorophosphate, (4-methoxyphenyl)phenyliodonium trifluoromethanesulfonate, bis(*p*-tert-butylphenyl)iodonium trifluoromethanesulfonate, triphenylsulfonium trifluoromethanesulfonate, (4-methoxyphenyl)diphenylsulfonium trifluoromethanesulfonate, (*p*-tert-butylphenyl)diphenylsulfonium trifluoromethanesulfonate, diphenyliodonium nonafluorobutanesulfonate, bis(*p*-tert-butylphenyl)iodonium nonafluorobutanesulfonate, triphenylsulfonium nonafluorobutanesulfonate and the like, of which, inter alia, those onium salts having a fluorinated alkyl sulfonic acid ion as the anion are preferable.

[0021]

This acid-generating agent component (B) can be used singly or can be used as a combination of two kinds or more. The compounding amount thereof is selected in the range from 0.5 to 30 parts by mass or, preferably, from 1 to 10 parts by mass per 100 parts by mass of the resin component (A). When this compounding amount is smaller than 0.5 part by mass, pattern formation cannot be fully accomplished while, when in excess over 30 parts by mass, a difficulty is encountered in obtaining a uniform solution resulting in a decrease in the storage stability.

[0022]

The composition of the present invention is used as a solution by dissolving the above-described resin component (A) and the acid-generating agent component (B) in an organic solvent (C). As the organic solvent used here, any ones can be used by adequately selecting one kind or two kinds or more as desired from those known as the solvent in the prior art chemical-amplification resists provided that a uniform solution can be obtained by dissolving the above described two components.

[0023]

Examples of such an organic solvent (C) include ketones such as acetone, methyl ethyl ketone, cyclohexanone, methyl isoamyl ketone, 2-heptanone and the like, polyhydric alcohols

and derivatives thereof such as ethyleneglycol, ethyleneglycol monoacetate, diethyleneglycol, diethyleneglycol monoacetate, propyleneglycol, propyleneglycol monoacetate, dipropyleneglycol and dipropyleneglycol monoacetate as well as monomethyl ether, monoethyl ether, monopropyl ether, monobutyl ether and monophenyl ether thereof, cyclic ethers such as dioxane and esters such as methyl lactate, ethyl lactate, methyl acetate, ethyl acetate, butyl acetate, methyl pyruvate, ethyl pyruvate, methyl methoxypropionate, ethyl ethoxypropionate and the like.
[0024]

It is particularly advantageous in the composition of the present invention to use a mixed solvent of at least one kind selected from propyleneglycol monomethyl ether acetate and ethyllactate and γ -butyrolactone. In this case, the mixing proportion is selected such that the mass proportion of the former and the latter is in the range from 70:30 to 95:5.
[0025]

It is optional in the composition of the present invention, in order to accomplish improvements in the resist pattern profile, holding stability and others that, according to need, a secondary lower or tertiary amine is contained as the component (D). Examples of this secondary or tertiary amine include trimethylamine, diethylamide, triethylamine, di-n-propylamine, tri-n-propylamine, tripentylamine, diethanolamine, triethanolamine and the like, among which trialkanolamine is particularly preferable. They can be used singly or can be used as a combination of two kinds or more.

These amines are used usually in the range from 0.01 to 0.2% by mass relative to the resin component (A).
[0026]

It is further optional according to desire that the composition of the present invention is admixed with and contains additives having miscibility such as, for example, auxiliary resins to improve resist film properties, surface active agents to improve coating workability, dissolution-reducing agents, plasticizers, stabilizers, coloring agents, halation inhibitors and others.

[0027]

As the method for using the inventive composition, any resist pattern-forming method in the conventional photoresist technology can be used but, in order to conduct satisfactorily, a substrate such as a silicon wafer is first coated on a spinner and the like with a solution of the resist composition and dried to form a photosensitive layer which is irradiated, for example, with ArF excimer laser beams on an ArF light-exposure machine through a desired mask pattern and heated. Next, the same is subjected to a development treatment with an alkaline developer solution such as, for example, a 0.1-10% by mass aqueous solution of tetramethylammonium hydroxide. In this manner, a pattern can be obtained with fidelity to the mask pattern.

Besides, while the inventive composition is particularly useful for ArF excimer laser beams, it is also effective for radiations having a still shorter wavelength such as F₂ lasers, EUV (extreme ultraviolet light), VUV (vacuum ultraviolet light), electron beams, X-rays, soft X-rays and the like.

[0028]

[Advantage of the Invention]

The inventive composition, which is of the chemical-amplification type, has high transparency to an active light of 200 nm or shorter wavelength or, in particular, ArF excimer laser beams and is capable of giving a fine resist pattern having, along with high sensitivity and pattern resolution, good resist pattern profile and exhibiting excellent dry etching resistance and adhesion to the substrate as well as little line slimming. Accordingly, it can be used satisfactorily in the manufacture of semiconductor devices necessitating ultrafine working and others as a positive-working resist of the chemical-amplification type using ArF excimer laser beams as the light source.

[0029]

[Example]

In the following, the present invention is described in more detail by way of examples.

Incidentally, the dry etching resistance and line slimming in each of the examples were measured by the following methods.

[0030]

(1) Dry etching resistance: Evaluation was made by measuring the film thickness reduction when treatment is conducted by using a gaseous mixture of tetrafluoromethane (CF₄), trifluoromethane (CHF₃) and helium (flow rate ratio 30:30:100) as the etching gas in an etching apparatus (manufactured by Tokyo Ohka Kogyo Co., trade name "OAPM-2400").

[0031]

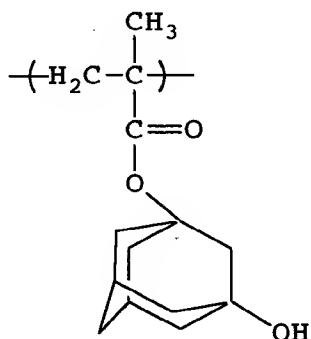
(2) Line slimming: Comparison was made by forming an isolated pattern and measuring the widths of the resist pattern before and after the irradiation by a measuring SEM (manufactured by Hitachi Ltd., trade name "S-8820").

[0032]

Example.

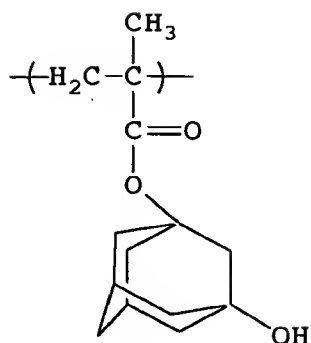
A solution of a positive-working resist composition was prepared by dissolving, in 700 parts by mass of propyleneglycol monomethyl ether acetate, 100 parts by mass of a copolymer (component A) having a mass-average molecular weight of 10,000 and consisting of (i) 40% by moles of the constituent units expressed by the formula

[Chem 7]



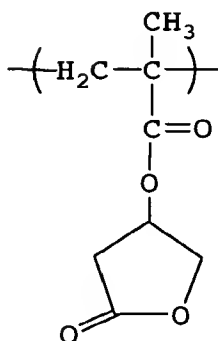
(ii) 20% by moles of the constituent units expressed by the formula

[Chem 8]



and (iii) 40% by moles of the constituent units expressed by the formula

[Chem 9]



2.0 parts by mass of triphenylsulfonium nonafluorobutanesulfonate and 0.2 part by mass of triethanolamine.

In the next, this resist solution was applied by using a spinner onto a silicon wafer provided with an organic antireflection film of 820 Å film thickness (manufactured by Shapely Co., trade name "AR-19") and dried on a hot plate at 140 °C (pre-baking) for 90 seconds to form a resist layer of 400 nm film thickness. Next, irradiation was selectively performed with ArF excimer laser (193 nm) on an ArF exposure machine (manufactured by ISI Co., trade name "Micro Step") followed by a heat treatment (PEB) at 120 °C for 90 seconds and then puddle development for 60 seconds with a 2.38% by mass aqueous solution of tetramethylammonium hydroxide followed by washing with water for 30 seconds and drying.

The resist pattern formed in this procedure had such a critical pattern resolution that a line-and-space pattern of

120 nm could be formed in 1:1.

Besides, the exposure time (sensitivity) there was measured in the unit of mJ/cm^2 (energy dose) to be $30.0 \text{ mJ}/\text{cm}^2$ and the profile of a 1:1 line-and-space pattern of 130 nm was excellently orthogonal to be a good resist pattern. No film falling was noted in this resist pattern to indicate good adhesion.

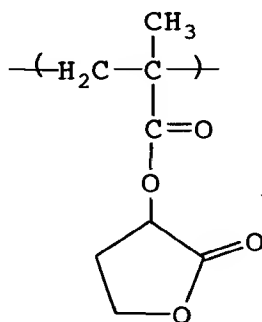
Further, the film thickness reduction as determined was 70 nm. Moreover, little change was noted in the line slimming wherein the initial 100 nm width of the resist pattern was reduced to 95 nm.

[0033]

Comparative Example 1.

A solution of a positive-working resist was prepared in the same manner as in Example excepting for the use of 100 parts by mass of a copolymer having a mass-average molecular weight of 10,000 and consisting of 40% by moles of the constituent units expressed by the formula (i), 20% by moles of the constituent units expressed by the formula (ii) and 40% by moles of the constituent units expressed by the formula (iv)

[Chem 10]



in place of the copolymer as the component (A) in Example.

Nextly, by using this resist solution, a resist pattern was formed in the same manner as in Example.

As to the resist pattern obtained in this way, a critical pattern resolution was found to be inferior that a line-and-space pattern of 130 nm could be formed 1:1.

The exposure time (sensitivity) there was measured to be 55 mJ/cm² and the profile of a 1:1 line-and-space pattern of 140 nm was excellently orthogonal to be a good resist pattern while the profile of a 1:1 line-and-space pattern of 130 nm was not good.

Besides, film falling, adhesion, dry etching resistance and line slimming of the above resist pattern were same as in Example.

[0034]

Comparative Example 2.

A positive-working resist solution was prepared in the same manner as in Comparative Example 1 excepting for the use of 100 parts by mass of a copolymer consisting of 50% by moles of the constituent units expressed by the formula (i), 0% by moles of the constituent units expressed by the formula (ii) and 50% by moles of the constituent units expressed by the formula (iv) and, nextly, a resist pattern was formed by using same.

As to the resist pattern obtained in this way, a line-and-space pattern of 130 nm was formed in 1:1, the sensitivity was 50 mJ/cm² and while the profile of a 1:1 line-and-space pattern of 140 nm was excellently orthogonal to be a good resist pattern, the profile of a 1:1 line-and-space pattern of 130 nm was not good.

Besides, film falling of the above described resist pattern was not noted and adhesion was found good.

Further, the film thickness reduction was 90 nm and, as to line slimming, the width of the resist pattern was changed from initial 100 nm to 85 nm.

[0035]

Comparative Example 3.

A positive-working resist solution was prepared in the same manner as in Example excepting for the use of 100 parts by mass of a copolymer consisting of 50% by moles of the constituent units expressed by the formula (i), 0% by moles of the constituent units expressed by the formula (ii) and 50% by moles of the constituent units expressed by the formula (iii)

and a resist pattern was formed by using same.

As to the resist pattern obtained in this way, a line-and-space pattern of 130 nm was formed in 1:1, the sensitivity was 44 mJ/cm² and the profile of a 1:1 line-and-space pattern of 140 nm was excellently orthogonal to be a good resist pattern while the profile of a 1:1 line-and-space pattern of 130 nm was not good.

Besides, film falling of the above described resist pattern was not noted and adhesion was found good.

Further, the film thickness reduction was 81 nm and, as to line slimming, the width of the resist pattern was changed from initial 100 nm to 85 nm.

[Name of document] Abstract

[Abstract]

[Problems] Provided is a chemical-amplification positive-working resist composition capable of giving a fine resist pattern with little line slimming in addition to the excellent sensitivity and pattern resolution as well as good dry etching resistance and adhesion to the substrate, when a light source of 200 nm wavelength or shorter such as ArF excimer laser is used.

[Means for solution] In a chemical-amplification positive-working resist composition containing a resin component (A) capable of being imparted with increased solubility in alkali by interacting with an acid, an acid-generating agent component (B) capable of generating an acid by irradiation with a radiation and an organic solvent component (C), the resin component (A) is a copolymer consisting of (a₁) constituent units derived from 2-alkyl-2-adamantyl acrylate or methacrylate, (a₂) constituent units derived from acrylate or methacrylate ester having an acid-dissociable 2-oxooxapentyl group and (a₃) constituent units derived from 1-hydroxyadamantyl acrylate or methacrylate.

[Figure selected] None

INFORMATION OF RECORD OF APPLICANT

Identification number	[000220239]
1. Date of change	30th August 1990
[Reason of change]	Newly registered
Address	150, Nakamaruko, Nakahara-ku, Kawasaki-shi, Kanagawa-ken
Name	TOKYO OHKA KOGYO CO., LTD.